Space Weather Technical Forecast

Issued on Wednesday, 24 May 2023 at 01:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Chance of R1/R2 radio blackouts. Active fluence becoming likely. Slight chance of G1/Minor Storm intervals.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Moderate with one M-Class flare of M3.0, peaking at 23/1213UTC from AR3311. This is the largest and most complex region approaching north centre disc, with a delta still visible within the intermediate spot area. AR3310 is the next largest region on the disc and is dominated by a large leading spot. The remaining three regions appear to be smaller and simpler at the present time.
No new Earth-directed CMEs have been observed in available imagery in the last 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE and DSCOVR at L1 are showing High Speed Stream (HSS) conditions, likely a connection to CH06/-. Wind speeds have been mostly elevated at 500-630 km/s. Density was at mostly average or below average levels, but with some slightly above average spells early in the period. The total IMF, Bt, started at moderate levels around 8-9 nT, but became weak through the period. The north-south component, Bz, was weakly variable, but predominately negative, ranging between +8/-7 nT. Phi angle has been predominantly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, has remained at background levels throughout. High energy electron flux (greater than 2MeV), as measured at GOES16, reached High levels at the diurnal peak with a maximum of 1400 pfu at 23/2345 UTC. The 24-hour integrated fluence has been below Active on a slight rising trend, with 4.4e7 integrated pfu recorded at 24/0000UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be Low to Moderate, with a chance of further M-class flares. The main risk is from AR3311 near north centre disc.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs expected, although a weak CME may give some glancing influence later on 26 May or early on 27 May, however it is considered more likely this CME will miss. Solar winds are currently at elevated levels, likely due to the HSS from CH06/-. This is a persistent feature from last rotation, and a further increase in wind speed, perhaps up to 650-700 km/s is possible given the wind strength last rotation. Wind speeds are expected to gradually ease through Days 3 and 4 (26-27 May).
Geomagnetic activity will be mainly Unsettled to Active at first due to HSS influence, with a slight chance of G1/Minor Storm intervals. Activity easing from the HSS through the period, but there is a low possibility of an increase late Day 3 into Day 4 should any glancing CME influence occur.

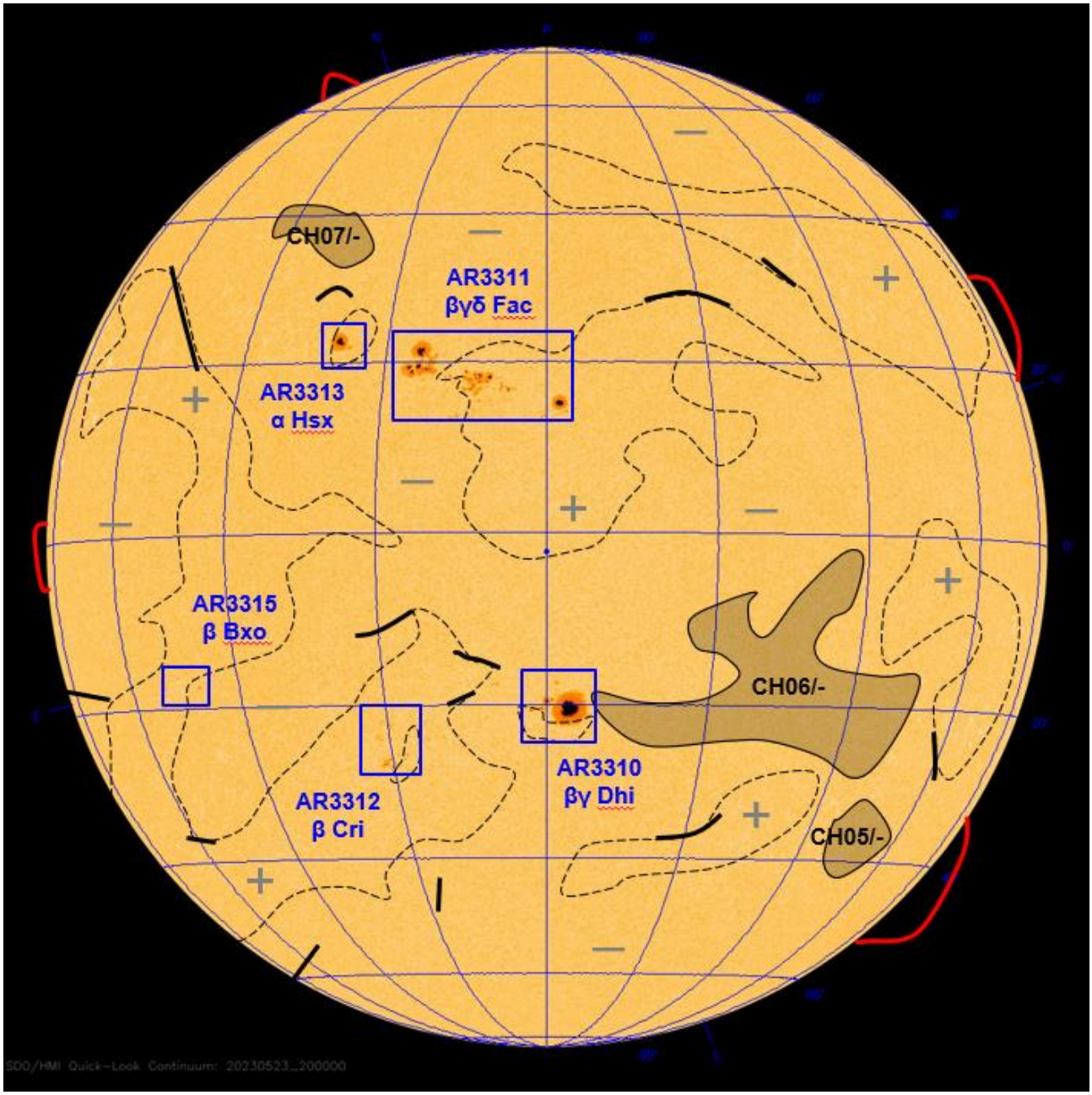
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at background levels, but there is just a slight chance of reaching the S1/Minor Storm threshold should any larger flares occur. High energy electron flux (greater than 2MeV) is

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

expected to continue to reach High levels at the diurnal peaks, with levels likely rising through the period. The associated electron fluence is also likely to rise, with Active (1e8 integrated pfu) conditions becoming likely.

Figure 1. Solar Analysis Valid 23/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Geomagnetic Storms:

Currently there are no Earth-directed CMEs, although a weak CME from the M1.9 flare of AR3312 at 22/1337 UTC is expected to pass close by, to the south of and behind Earth. Enlil ensemble members indicate a very slight risk of a glancing blow later on 26 May or early on 27 May, however it is considered more likely this CME will miss.

Solar winds are currently at elevated levels between 500-600km/s, likely due to the HSS from CH06/-, a large feature in the southwest disc. The onset of these winds were considered too early but it now seems likely that CH06 is the source. This is a persistent feature from last rotation, and a further increase in wind speed, perhaps up to 650-700 km/s is possible given the wind strength last rotation. Wind speeds are expected to gradually ease through Days 3 and 4 (26-27 May), later than suggested by Enlil.

Geomagnetic activity will be mainly Unsettled to Active at first due to HSS influence, with a slight chance of G1/Minor Storm intervals. Activity easing from the HSS through the period, but there is a low possibility of an increase late Day 3 into Day 4 should any glancing CME influence occur.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

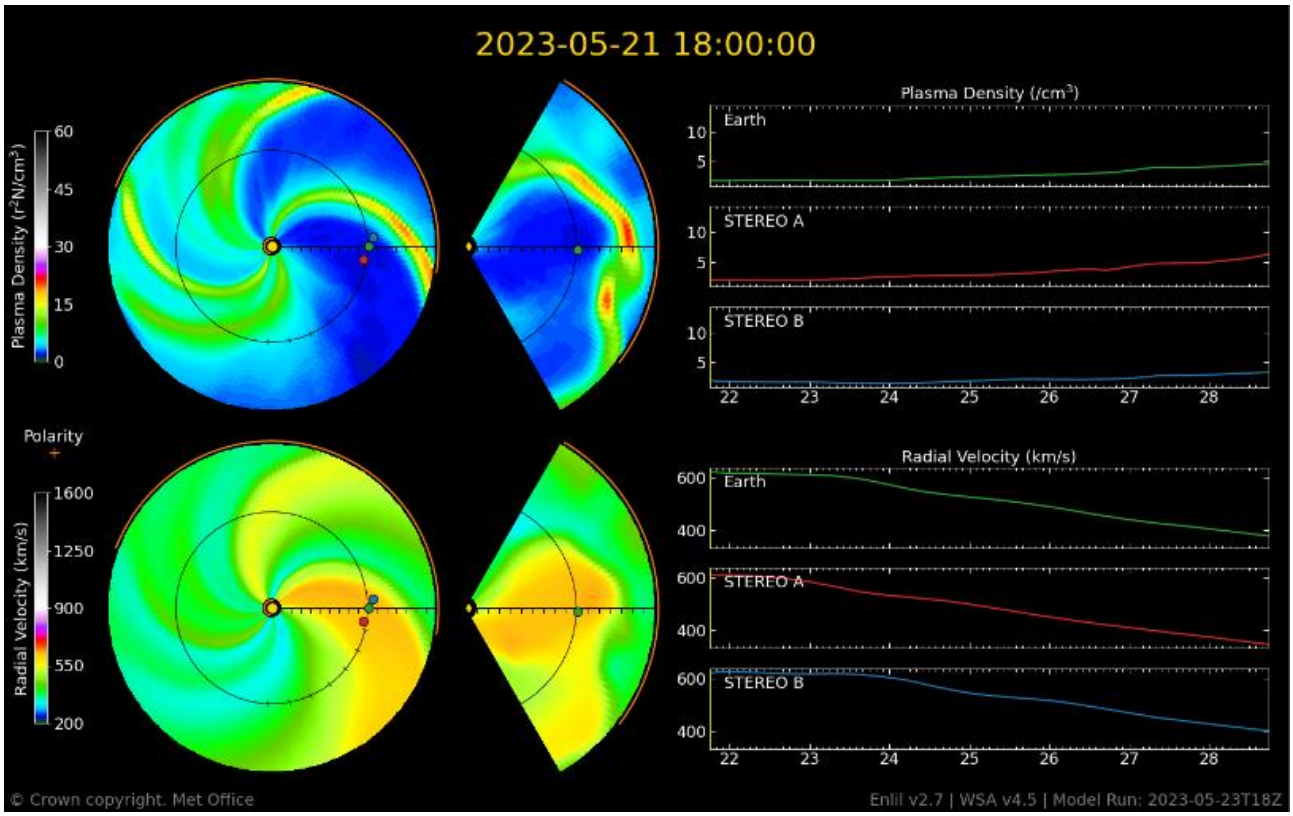
Geomagnetic Activity - Earthbound Coronal Mass Ejections

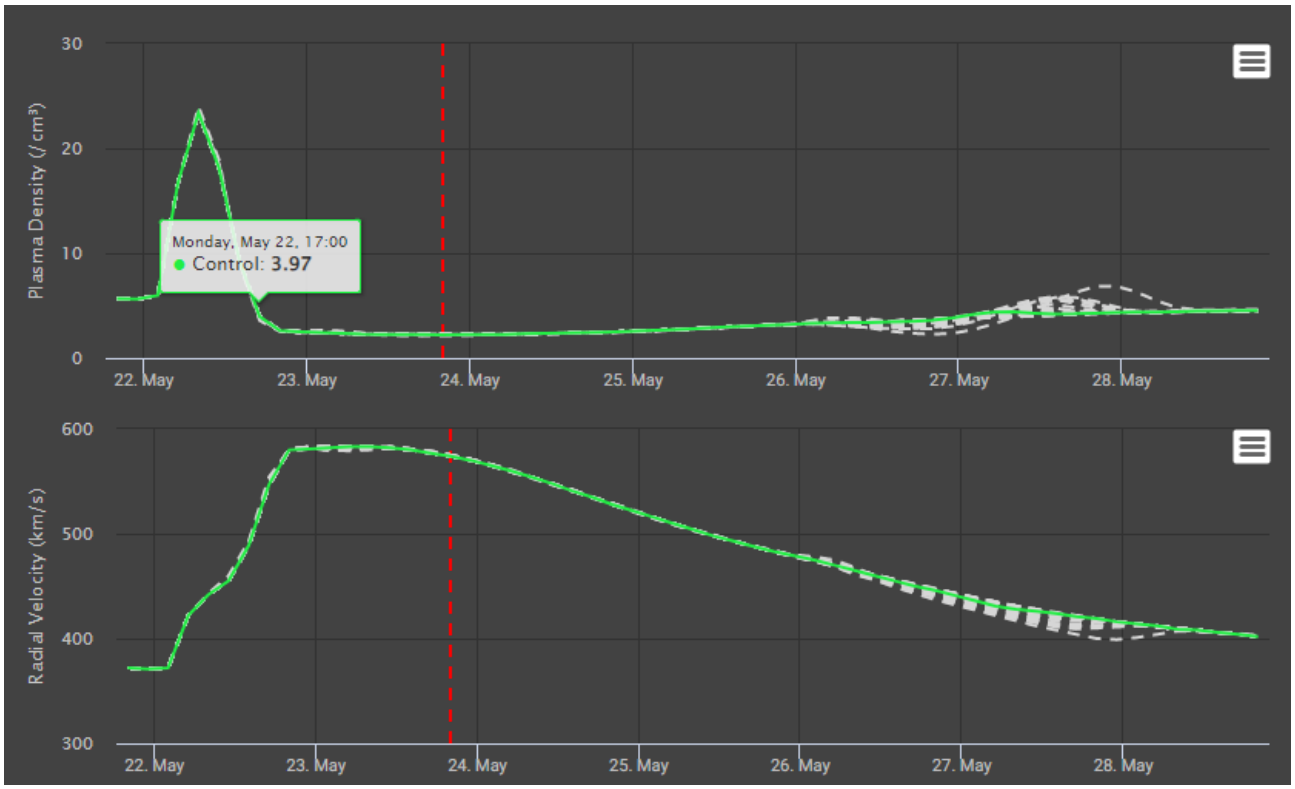
Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Figure 2: MOSWOC Enlil model and ensemble. Enlil is likely to be decreasing wind speeds too soon, with CH06 a large feature speeds are likely to remain higher for longer. The ensemble has a few members suggesting a low risk of a glancing CME blow later in the period.





Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

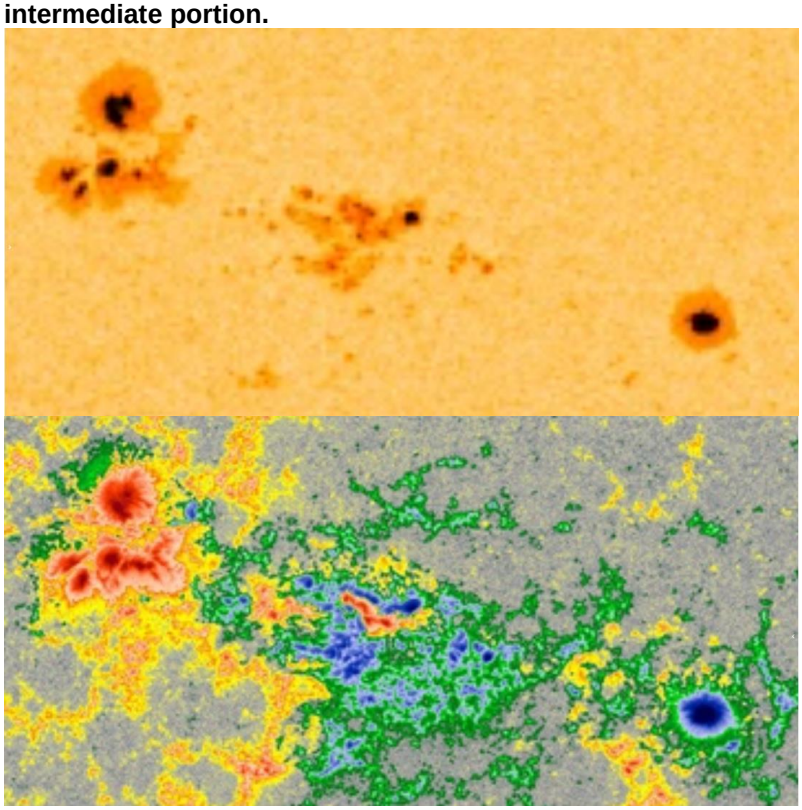
Radio Blackouts - X-Ray Flares:

There are currently five sunspot regions on the visible disc. AR3311 (Fac/Beta-Gamma-Delta) approaching north centre disc is the largest and most complex region on the disc, with a small delta still visible within the intermediate spot area. This region does appear to be showing a stabilising trend, however. AR3310 (Dhi/Beta-Gamma), consists of a large leader spot, with a couple of much smaller trailing spots. It does maintain some minor magnetic complexity, however. The remaining regions are all relatively small and simple or stable.

STEREO-A imagery suggests that there may be one or two new regions to rotate onto the disc within the next 24 hours. For now, flare probabilities have been kept flat through the period as no regions are due to rotate off and we will need to wait for new regions to become visible before they can be assessed.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: SDO intensitygram and magnetogram showing AR3311, with a small delta visible in the intermediate portion.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux, as observed by GOES16, has remained at background levels throughout and is expected to remain similar throughout the period. However, there is the potential for some enhancement should any larger flares occur, most likely from AR3311 or perhaps AR3310 as they rotate westward through the period, but also from regions that have recently rotated beyond the western horizon. As such a slight risk is maintained throughout.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

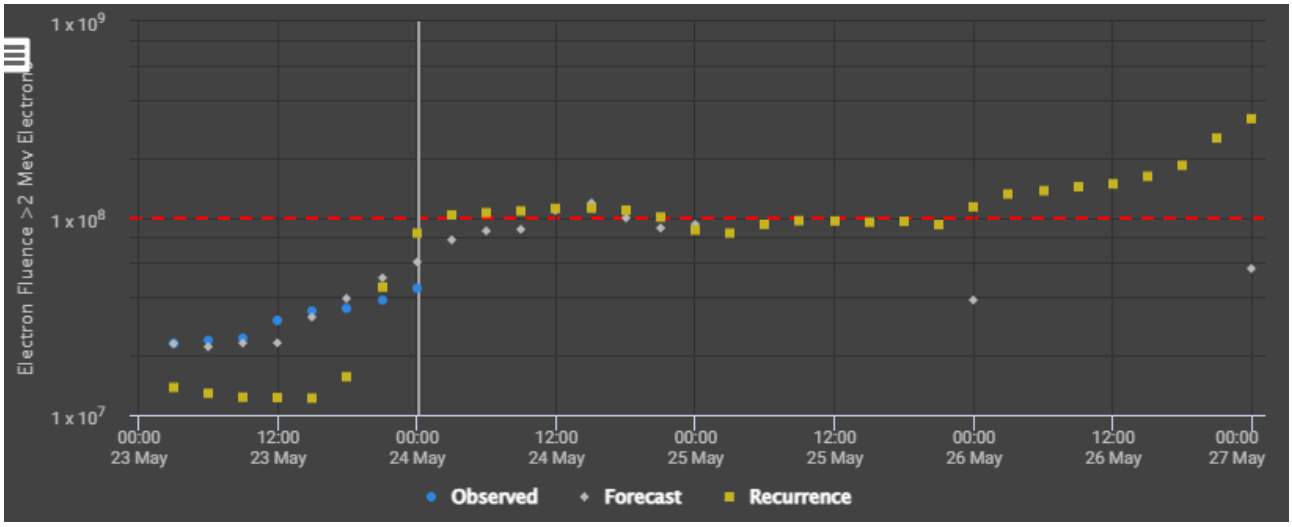
© Crown Copyright 2023. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) as observed at GOES-16, has just been reaching High levels at the diurnal peak for the last few days. This is likely a consequence of an increase in electrons from the recent solar wind enhancements. However, the current elevated or perhaps strong solar wind speeds are likely suppressing the observed flux at GEO due to the compression of the Van Allen belt to below this level. With a gradual easing of solar wind pressure expected during the period, counts are expected to rise at GEO, making increasingly long periods of High flux more likely as the period goes on.

The associated 24 hour electron fluence is most likely to remain below the Active (1e8 integrated pfu) threshold at first, probably on a rising trend, with an increasing likelihood of fluence rising above Active during the period. This rising trend is supported by REFM in the next 24 hours, although beyond that it is then forecasting a decrease. These levels seem likely to be a little low, with fluence on the previous rotation rising above Active suggesting a similar rise is likely.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	40	50	70	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM forecasting a rise above Active in the next 24 hours, then forecasting a decrease. Due to the current elevated wind speeds, a rise above Active seems more likely once the wind speeds start to ease during the period.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.